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Enzyme-catalysed hydrolysis of L-amino acid esters in a low water organic solvent studied by isothermal calorimetry

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Abstract

Isothermal calorimetry and UV-visible spectrophotometry have been used to study the thermochemistry of the enzyme-catalyzed hydrolysis of hydrophobic L-amino acid esters in organic solvents with low water content at 298 K. The p-nitrophenyl esters of Z-L-tyrosine and Z-L-phenylalanine were used as model hydrophobic substrates. Acetonitrile was used as a model organic solvent. A special preparation protocol of the reactants in the calorimetric vessel was applied in order to determine the heat effects accompanying the enzyme-catalyzed hydrolysis reaction in organic mixtures with low water content and the Tris buffer ionization enthalpies over the whole range of water content in acetonitrile. It was found that the molar enthalpy of the hydrolysis of p-nitrophenyl esters and buffer ionization enthalpy depend significantly and similarly on the water content in acetonitrile. However, the reaction enthalpy corrected for the buffer ionization enthalpy does not depend on the water content in organic solvent mixtures. An explanation of the effect of the selected organic solvent on the thermochemical parameters was provided on the basis of the IR spectroscopic data for the hydrogen bond network of water in acetonitrile. The results obtained show that the state of water in organic solvents is an important factor that determines the reaction enthalpy as well as buffer ionization enthalpy.

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Keywords

Acetonitrile, Biocatalysis in organic solvents, Bovine pancreatic α-chymotrypsin, Buffer ionization enthalpy, Ester hydrolysis, Isoperibolic batch calorimetry, Reaction enthalpy